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ABSTRACT

The 2000 "High Schools That Work" (HSTW) Assessment showed a definite payoff among career-oriented students who used technology. In their 2000 annual reports to the Southern Regional Education Board, many HSTW sites listed technology-related accomplishments: getting students to use the Internet to gather information; teaching students to use computers, printers, scanners and digital cameras in completing challenging projects; and earning awards for student accomplishments in technology use. National studies have revealed that students who have access to computer-assisted instruction and other technology-related experiences show achievements gains on various tests. This Outstanding Practices publication contains 21 examples of how educators are using technology to improve instruction and raise student achievement in academic and career/technical courses. These are just some of the exemplary practices from the more than 1,100 HSTW sites in 26 states. The reports from schools are divided into three sections: "Academic Courses," "Career/Technical Programs," and "Integrated Academic and Career/Technical Studies." (AEF)

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SREB

HIGH SCHOOLS THAT WORK

# Using Technology to Improve Instruction and Raise Student Achievement

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OUTSTANDING PRACTICES

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SREB

# Using Technology to Improve Instruction and Raise Student Achievement

Southern Regional Education Board

OUTSTANDING PRACTICES

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# What role does technology play in raising student achievement?

*By Gene Bottoms*

Georgia Gov. Roy Barnes, chairman of the Southern Regional Education Board, said it this way: "Technology is as essential to a teacher today as the old blue-back speller was in the old days."

Practically every American school is connected to the Internet, and many teachers know how to use computers and "digital content" in their classrooms. The challenge is to accelerate the use of technology in preparing all students for a world that relies heavily on high-tech methods and devices as well as on high-level academic skills.

The 2000 *High Schools That Work* Assessment showed a definite payoff among career-oriented students who used technology. These students had increases in reading, mathematics and science in direct proportion to growth in the use of computers to complete academic and career/technical assignments.

In their 2000 annual reports to SREB, many *High Schools That Work* sites listed technology-related accomplishments: getting students to use the Internet to gather information; teaching students to use computers, printers, scanners and digital cameras in completing challenging projects; and earning awards for student accomplishments in technology use.

## *National studies*

National studies have revealed that students who have access to computer-assisted instruction and other technology-related experiences show achievement gains on various tests. A technology-rich school environment motivates students, strengthens their academic and career/technical skills, and helps them relate to the real world.

Two studies of the West Virginia technology education program — the nation's longest-running state program for the implementation of technology in education — showed that technology can lead to improved skills in reading, writing and mathematics. One of these studies credited technology with helping low-income and rural students to keep pace with other students.

*HSTW* sites are encouraged to use technology in motivating students and in engaging them actively in learning academic and career/technical concepts. It's not enough to have computers in classrooms. Teachers must plan to use technology to help students learn.

## *Teacher training*

Education Week reported that teachers who have more technology training are more likely to use the Internet and other high-tech tools in their classrooms, feel better-prepared to use these teaching aids, and rely on them more heavily than do teachers with less training. In gauging the importance of professional development, Education Week concluded that it matters more whether teachers have been trained to use technology than how long they have been teaching.

This Outstanding Practices publication contains 21 examples of how educators are using technology to improve instruction and raise student achievement in academic and career/technical courses. These are just some of the exemplary practices from the more than 1,100 *HSTW* sites in 26 states.

We invite you to read what these teachers are doing, contact them for more information, adapt the practices that will work in your school and let technology be your partner in improving teaching and learning for all students.

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*Gene Bottoms is senior vice president of the Southern Regional Education Board and founding director of* High Schools That Work.

# Academic Courses

## Teacher's longtime interest in computers contributes to students' language arts skills

Students in grades seven, eight and nine at Sheffield High School in Memphis, Tenn., are lucky. Their language arts teacher, Geraldine Barnes, has been learning computer programs since the 1980s. Now she is passing along this knowledge in a technology-rich classroom where students enhance their reading, writing and speaking skills.

Seventh-graders create Web sites; eighth-graders do research on the Internet and develop PowerPoint presentations; ninth-graders write scripts and make videos of scenes from *Romeo and Juliet.* Every student has an e-mail address.

While studying the book *Out of the Dust,* eighth-graders used the Internet to learn more about the Dust Bowl years of the Great Depression, used word processing to keep journals of their reactions to what they read, and created illustrations in PowerPoint. They also wrote letters from characters in the book to ask President Roosevelt for aid.

### *All students benefit*

Barnes says that career-bound and college-preparatory students all can benefit from an instructional approach based on technology and projects. Students take responsibility for their own learning, and teachers have more free time to work with students individually.

"My goal is to raise students' achievement — not simply to teach computers," Barnes said. "I see technology as a means to an end."

Barnes places project assignments on the school Web site so students can check on what they are supposed to do. They are expected to develop one product in each grading period. In one project based on Rudyard Kipling's story of Rikki-Tikki-Tavi, groups of students develop brochures to inform others about cobras. Each group creates a title, writes the text, finds illustrations (photos and artwork) and designs a brochure. The teacher lists specific questions that she wants the students to answer in the brochures and gives them a Web site with guidelines for use in editing and proofreading their work. She also provides links to Web sites that contain useful facts and to scoring guides that she uses in evaluating the finished products. Students receive grades on their writing and on how they worked in their groups. Each group member is expected to contribute to the project.

*Funding for computers*

Students have access to computers (one for every two students), software packages, printers, scanners, and both digital and regular video cameras. Barnes began building the technology supply when she applied for and received a $56,500 grant from Goals 2000 to buy technology equipment for a summer journalism camp for sixth- through ninth-graders. She later received a $1,200 technology grant from the Tennessee Department of Education.

The three-week journalism camp motivated students to use technology and helped them to improve their writing. The students produced a newspaper — called Represent — that they placed on the school's Web site. The paper contains articles, book reviews and photos taken at camp. The students also took field trips to the journalism department at the University of Memphis and to the Memphis Commercial Appeal newspaper to see modern journalists at work. One student said, "The writing and technology skills I learned at camp will help me with what I am already learning in school."

Barnes, who says she always has liked "gadgets," got interested in computers when she was working on her master's degree. She learned word processing and desktop publishing when most people still were using typewriters, and she has continued to take courses to learn new programs and new applications of technology. She also said she learns by attending technology training at state and national conferences.

"Take computer classes and get training," Barnes advises other teachers. "Be willing to learn from your students."

When she wanted to use Sony PlayStation's reading and grammar games to help students prepare for state-mandated tests, Barnes asked the students how to play.

"I have seen definite improvement in students' reading and writing skills as a result of technology," she said. "I have also seen gains in students' critical thinking and decision-making skills and in their ability to work independently and in groups."

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**Contact: Geraldine Barnes, Language Arts Teacher**
**Sheffield High School**
**4315 Sheffield St.**
**Memphis, TN 38118**
**Phone: (901) 366-2370**
**Fax: (901) 366-2407**
**E-mail: barnesg@k12tn.net**

# High-quality lesson plans 'a mouse-click away' in West Virginia

Web-based lesson plans are really "cooking" at Wheeling Park High School in Wheeling, W.Va. In fact, they're "cooking with chocolate."

Ninth-graders in Lynn Blaney's science class did online research in designing solar cookers, which use the sun's energy to cook food. After choosing a design — one Web site offered 50 designs — the students gathered the materials, including aluminum foil and pizza boxes, to build their cookers.

They evaluated the cookers for efficiency, measured temperature increases, graphed the results, compared the designs' performance and picked the most efficient ones. They used the cookers to prepare s'mores — treats made of chocolate, marshmallows and graham crackers.

## *Weather forecast from the Internet*

Students even collected weather data from the Internet to make sure they picked a day and a time when the sun would be shining to melt the marshmallows and the chocolate.

"Students who had never produced anything in any other class were using their solar cookers to make food," Blaney said. "In this project, they learned that solar energy is used for cooking in Africa and other parts of the world." The activity was part of a unit on alternative energy.

High-quality lesson plans that use technology to teach academic subjects are just "a mouse-click away" in West Virginia. They are part of the West Virginia Reinventing Education database, which contains hundreds of lesson plans that teachers have field-tested and evaluated. The plans are based on specific goals for each curriculum area. Through this database, teachers statewide can communicate and collaborate with one another.

## *Business, education partnership*

Reinventing Education is a partnership between the West Virginia Department of Education and IBM. State coordinator Donna Landin said the program's purpose is to design, test and implement instructional plans that draw upon the Internet's vast resources. Each lesson is aligned with specific West Virginia instructional goals and objectives, national standards and workplace skills. And each one contains an assessment for measuring students' progress toward instructional goals.

The plans initially identified effective ways to use information from the Internet to improve mathematics achievement in grades six through 12. By 1997 when the project was two years old, the scope had increased to include language arts for grades 10 through 12, science for grades nine and 10, and geography for grades seven through nine. The database now contains 700 lessons, 1,500 activities, 1,000 assessments, 400 rubrics (scoring guides) and 3,000 resources, such as Web sites, books, kits and CD-ROMs.

The lessons prepare students for the workplace by identifying skills that businesses demand, such as communication and problem-solving. Blaney's eight years in industrial research and development revealed what it takes to be successful in a business environment.

"My students create a product based on what they have learned. Then they make an oral presentation to share the new knowledge. This builds students' communication skills and prepares them to defend their beliefs and persuade others," said Blaney, who is serving as curriculum coordinator for West Virginia University's Health Sciences and Technology Academy and will return to Wheeling Park High School in July 2001.

### *Training other teachers*

Blaney's approach has inspired other teachers. When her ninth-grade students used PowerPoint software to prepare multimedia presentations on the solar system, other teachers visited her classroom to observe them. Blaney taught teachers to use PowerPoint and Inspiration, a concept-mapping program.

The ninth-grade science lesson that Blaney developed for the Reinventing Education Web site helps students look at traditional and alternative energy sources. Students conduct research on the Internet, select an alternative energy source and tell why it would be feasible in West Virginia. In doing so, students discover the strengths and weaknesses of energy sources such as solar power and hydroelectric power.

Reinventing Education is not just for teachers. It also is accessible to students, who are encouraged to use the links in the lessons they are completing. In using the Web site, students practice their reading and analytical skills and learn to work independently.

"Students have to be able to read and comprehend to get the information," Blaney said. "They learn to pick and choose and to focus on the information that will help them accomplish their tasks."

Scores on traditional assessments improved after Blaney started using the online lessons. Although she can't attribute the improved student achievement solely to technology, she is convinced that the Reinventing Education lessons are more effective than

traditional lessons. "Students are more engaged and take more responsibility for their own learning," Blaney said.

Students who have struggled academically "blossom" as they work on the Internet-based assignments. "They get involved in learning and produce some incredibly fine products," Blaney said. "They no longer ask me to walk them through every step."

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**Contact: Lynn Blaney, Curriculum Coordinator**
**Health Sciences and Technology Academy**
**West Virginia University**
**P. O. Box 9026**
**Morgantown, WV 26506-9026**
**Phone: (304) 293-1651 or (800) 345-4267 in West Virginia**
**Fax: (304) 293-0574**
**E-mail: Lblaney@hotmail.com**

**Donna Landin, Coordinator**
**WVDE/IBM Reinventing Education**
**West Virginia Department of Education**
**1900 Kanawha Blvd. E.**
**Charleston, WV 25305**
**Phone: (304) 558-7880**
**E-mail: dlandin@access.k12.wv.us**
**Web site: http://reinvent.k12.wv.us**

**Wheeling Park High School**
**1976 Park View Road**
**Wheeling, WV 26003**
**Phone: (304) 243-0400**
**Fax: (304) 243-0449**
**E-mail: lblaney@1st.net**
**Web site: http://wphs.ohio.k12.wv.us/**

## Weather project helps hone students' mathematics skills

A chance meeting at a science fair and some governmental belt-tightening sent students at Northside High School in Fort Smith, Ark., in high-tech pursuit of storm damage — and improved their mathematics and science skills at the same time.

Fort Smith residents worried when the National Weather Service reduced the number of employees in its local office, especially after a major tornado hit the downtown area. Many residents had received no tornado warning.

Later, when some National Weather Service employees were judging a district science fair, they overheard a Northside student describing the school's Global Positioning System (GPS) units. Students take these units to the scene of storm damage, use them to send and receive signals from orbiting satellites, and then enter the information into a computer that produces a map showing the latitude, longitude and elevation of the damage in relation to the Earth's surface. The weather professionals wondered whether the students could help them by using the units to log the coordinates of any storm damage within a 30-mile radius of Fort Smith. The students could e-mail the data to Tulsa, Okla., where National Weather Service specialists could compare the students' reports of actual storm damage with the Doppler radar estimates of where storm damage might have occurred. The comparison would allow weather officials to determine the extent to which radar estimates of where damage may have occurred varied from the actual damage that took place.

### *Sophisticated equipment*

The students agreed to participate, and the project became part of the NorthSTAR lab. (The "STAR" in NorthSTAR stands for Science Technology Applications and Research.) The lab is modeled after a community service program at Greenbrier High School in Greenbrier, Ark. Programs at both schools give students hands-on contact with sophisticated hardware and software in solving community problems.

In the NorthSTAR lab, 11th- and 12th-graders decide which community-based projects to undertake to test their skills in research, communication, planning and implementation. Projects may be short-term, such as helping local residents solve computer problems, or long-term, such as working with the National Weather Service to assess storm damage. In one project, students have mapped an alternative route for a local street to prevent the destruction of a bird sanctuary in a local park. Students also have used a computer to design a virtual model — and have created a small-scale physical model — of the Fort Smith landfill to demonstrate how the community buries solid waste.

The projects bring students face to face with engineers and other community members whose careers emphasize mathematics and science.

"I always am impressed by the quality of the students' work and the cooperation they exhibit in completing the projects," said Charles Besancon, who teaches applied physics at Northside High School. "If a student gets behind in the project, other members of the team come to the rescue or encourage the student to meet the deadline."

## *Uses of technology*

In the weather project, the students map coordinates, chart geographical information, send and receive e-mail, and develop special databases to trace storm damage in the area. They then forward the information to the National Weather Service in Tulsa. The students also created a PowerPoint presentation on storms, tornadoes, safety rules and the school's effort to improve weather forecasting. They show this presentation to students in local elementary schools and junior high schools.

"As the facilitator, I have attempted to connect the scientific aspects of satellites, meteorology and technology to the human aspect of service to our community," said Besancon. "I try to provide opportunities for students to discover the excitement of working with high-tech equipment in solving real-world problems and to gain the special feeling that comes from being of service to others."

Besancon said students have begun the school year with no knowledge about the hardware and software of GPS units but, by the end of the year, can use the units to record and send highly sophisticated information.

"The students know more about some of these things than most adults do," Besancon said.

Although he does not yet have data to show academic improvement, he said he is sure the projects have increased students' skills in mathematics, communication, analysis and problem-solving. He is developing a way to show students' progress.

More than a dozen state and national companies have made contributions to help the school obtain state-of-the-art computers, software and GPS units.

Students have learned how to work with sophisticated software that operates on powerful computers. They have learned to use presentation software and to communicate with adults via phone, e-mail and written correspondence. Students maintain the computer server, the listserv, e-mail accounts, a Web site and an operating system (Windows NT); they must be able to solve any problems they encounter. They also helped wire the room where they do their work, and they installed the operating system and every piece of software.

---

**Contact: Charles F. Besancon, Applied Physics Teacher**
**NorthSTAR Lab**
**Northside High School**
**2301 N. B St.**
**Fort Smith, AR 72901**
**Phone: (501) 783-1171**
**E-mail: cbesanco@nside.fssc.k12.ar.us**

# Georgia's InTech program boosts teachers' technology prowess

Bonnie Gaunt of Buford High School in Georgia once used her computer skills more as a shopper than as a teacher. "I could shop on the Internet, but I didn't know how to use the computer to help my students learn mathematics," Gaunt said.

Then she enrolled in Georgia's popular InTech program, which uses a "train-the-trainer" approach to prepare educators to teach their colleagues about using computers to engage students in learning. "Even someone who has no knowledge of technology can participate in the InTech training," Gaunt said.

The InTech program consists of 50 hours of training in computer skills, such as how to use various software packages, how to gather information from the Internet, and how to set up and use an e-mail account. Teachers keep electronic journals and create brochures based on information from the Internet.

## *InTech training*

Georgia launched InTech — the first phase of the Georgia Framework for INtegrating TECHnology in the Student-Centered Classroom — in January 1998. InTech training is conducted at 13 educational technology training centers and local school systems to prepare elementary, middle grades and high school teachers to use technology in instruction. Nearly 15,000 teachers and future teachers have participated in InTech training.

Beth Holmes, InTech co-developer and director of the Educational Technology Training Center at Columbus State University in Columbus, Ga., says the program is designed to help educators use modern technology as a catalyst to improve schools and raise student achievement. Participants develop skills in five areas: 1) use of modern technology; 2) classroom management; 3) new designs for teaching and learning; 4) enhanced teaching practices; and 5) focus on curriculum content standards. During InTech training, teams of teachers learn basic technology skills while focusing on project-based activities connected to Georgia's Quality Core Curriculum content standards.

Gaunt's experience left her enthusiastic about using computers in the classroom. She was especially interested in PowerPoint, a multimedia software program. An InTech instructor demonstrated how to use PowerPoint in delivering a sample lesson based on state standards. Participants then were required to plan, develop and deliver an original lesson in their own classrooms.

The InTech training also introduced Gaunt to many new hardware and software resources. One software product enables students to enter ideas or numbers and orga-

nize them into outlines, graphs and 3-D images. InTech participants typically are comfortable using basic production software, instructional software, digital cameras, flatbed scanners and the Internet.

### *In the classroom*

Back in the classroom, Gaunt began to use Buford High School's array of technologies, which include computer labs, classroom computers (at least three per classroom), a digital camera and Smart Boards. Smart Boards are large electronic "chalkboards" that transfer teachers' handwritten notes into computers that print them in a standard font for students. In the 2000-01 school year, students will create a Web page that contains mathematics-related projects.

In one project, students are asked to focus on a country. They figure a budget for visiting the country, the cost of living there temporarily or permanently, the currency exchange, the cost of tourist attractions in American dollars, and the mileage from one city to another.

In studying specific concepts in geometry and trigonometry, Gaunt's students did further research on the Internet to examine rockets' pathways in space. By examining the trajectory of a rocket, they learned that some geometric functions are based on a curve rather than on a flat surface (like the geometric functions they study in high school).

Gaunt teaches students to use PowerPoint to develop presentations. The software enhances book reports and term papers by forcing students to organize their thoughts and create high-tech presentations that use animated pictures and sound.

"Technology enables students to do the types of things that they have always done — only better," Gaunt said. "Students still need to express their thoughts clearly and write in complete sentences, but now they can make their presentations look and sound more professional.

"When they make more effort, they get better grades. Most of my students scored higher on their projects when they began using technology. It has motivated students at all levels, particularly at the lower levels."

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**Contact: Bonnie Gaunt, Mathematics Teacher**
**Buford High School**
**2750 Sawnee Ave.**
**Buford, GA 30518**
**Phone: (770) 945-6768**
**Fax: (770) 932-7570**
**E-mail: bgaunt@bufordcityschools.org**
**Web site: www.bufordcityschools.org**

**Beth Holmes, Director**
**InTech Program**
**Educational Technology Training Center**
**Columbus State University**
**Clearview Hall I, Room 108**
**4225 University Ave.**
**Columbus, GA 31907-5645**
**Phone: (706) 565-3645**
**Fax: (706) 565-3648**
**E-mail: Holmes_elizabeth@colstate.edu**
**Internet site: http://intech.ga-edtech.org/**

# Students use portable computers in community projects

The New Church congregation in suburban Oklahoma City had a nice pond — but no fish. So church leaders turned to Putnam City High School students for help. Armed with hand-held computers and water quality probes, the students descended on the lake. They measured the water's clarity, temperature, pH level, dissolved oxygen and suspended solids.

Back in the classroom, the students downloaded the data, created a spreadsheet, analyzed the results and pinpointed the problem. The lake had a very low amount of dissolved oxygen and a high level of organic material. To make the water suitable for fish, the pond would need to be aerated.

Bob Melton, science curriculum coordinator for the Putnam City Schools, says the portable computers literally have put technology into students' hands. The school system is buying one portable computer for every classroom at the high school and the middle school. Additional computers will be available in the high school's science lab.

## *Thinking and learning*

Melton says the portable computers are tools — like pencils, pens or yardsticks — that students can take on field studies. Students don't have to know how the computers work — just what they will do. The emphasis is on thinking and learning.

"In the span of a few seconds, students can hook up and begin exchanging information," Melton said. An infrared interface allows users to beam data to one another.

In the past, students had to measure dissolved oxygen in the field, return to the classroom and plot the numbers on paper. A probe-equipped portable computer allows students to see the numbers immediately in various formats, such as bar graphs and pie charts.

### *Analyzing information*

Environmental science teacher Scott Martin said technology becomes "second nature" to students after they overcome their initial fears. Instead of worrying about doing a particular test correctly, students can concentrate on analyzing the information.

Martin's students have used hand-held computers for several community projects, including doing animal behavior studies with the Oklahoma City Zoo and helping forestry officials restore vegetation to the banks of streams.

The Oklahoma Fish and Wildlife Department asked the students to collect data on the water quality of a pond in a park near the school. State officials will use that data in establishing the pond as a fishing lake.

### *Block schedule*

Putnam City High School operates on a block schedule of semester-length courses. Martin spends the first nine weeks teaching students how to measure water quality. Students later write proposals for projects. One student tested various types of sunscreen to determine how well they protect sunbathers from ultraviolet radiation and presented the results to area pool managers and lifeguards.

Students use Excel software to create tables and PowerPoint software to create presentations for their projects. They keep journals of their weekly progress.

"There is no doubt that these students are becoming better communicators," Martin said. "They have to gather and interpret data and put the information in a format that everybody can understand."

The students' report for the church defined dissolved oxygen, reported the level in the church's pond and told how much is needed to sustain fish life.

### *Seeing the value of mathematics*

Technology has enabled the district to make subjects such as mathematics more relevant to students. By using mathematics in real-world projects, students see that academic skills are important to their future plans.

Martin has noticed that students are beginning to identify real-life science problems (Why are there no toads around here?) and possible solutions (Have you thought about the many fertilizers being used?). "Students start brainstorming and it snowballs," Martin said.

Melton said the school district believes in rigor and relevance for all students, and there is evidence that high standards are producing results. Five years ago, 47 percent of Putnam High School students took core language arts, mathematics and science courses; in 2000, more than 60 percent of students were taking these courses. Even though more students (not just the highest-performing students) are taking the ACT test for college admission, the district's average scores have not declined.

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**Contact: Scott Martin, Environmental Science Teacher**
**Putnam City High School**
**5300 N.W. 50th St.**
**Oklahoma City, OK 73122**
**Phone: (405) 789-4350**
**Fax: (405) 789-1662**
**E-mail: scottm@putnamcityschools.org**

**Bob Melton, Science Curriculum Coordinator**
**Putnam City Schools**
**5401 N.W. 40th St.**
**Oklahoma City, OK 73122**
**Phone: (405) 495-5200**
**Fax: (405) 491-7514**
**E-mail: bmelton@putnamcityschools.org**

## School district provides online training, lesson plans

Teachers in the Floresville Independent School District in Texas learn how to produce technology-based lesson plans that they share with one another via the Internet. As part of the district's project to integrate technology across the curriculum, teachers must submit at least 10 lesson plans per year that link technology and academic learning.

The school district's Web site is rich in step-by-step help. For computer beginners, there are tutorials in how to use icons and tool bars, move and resize items, and manage files. Other online tutorials guide teachers and students in using the Internet, PowerPoint software for presentations, and FrontPage software for Web pages.

Melissa Ramos, coordinator of Floresville's instructional technology project, says the district recognizes that helping teachers learn to use computers is an important part of integrating technology into teaching and learning. The district is putting a $1 million grant toward training teachers to use 21st-century instructional methods in the classroom.

### *Building skills and confidence*

"Our program focuses on building teachers' skills and confidence in using technology to make their classes more student-centered," Ramos said.

The Floresville lesson plans are available to anyone with Internet access. "The project has been so successful that we are adding a new database that will enable teachers to put even more lesson plans on the Web site," Ramos said. "Teachers enjoy being able to get ideas from other teachers."

The district's Web site provides step-by-step instructions for how to create a lesson plan, including organizing, writing and formatting the plan on the computer. Teachers are encouraged to suggest ways that other teachers can modify the plan to suit different circumstances (such as too few computers, students with special needs or advanced students).

The Web site makes it easy for teachers to align their lesson plans with the Texas Essential Knowledge and Skills — the state's instructional objectives — that include technological applications of knowledge. Teachers can get tips on videoconferencing and virtual field trips as well as instructions on how to use digital cameras, scanners and Internet images to liven up the lesson plans.

### *Equipment to support instruction*

More than 200 teachers from all grade levels and subjects have been trained to use technology and develop lesson plans since 1999, and the district makes sure they have access to the equipment they need to practice their skills and implement the lesson plans. Each classroom has two connections to the Internet. Every technology-trained teacher has access at least once a week to a cart equipped with a computer, a big-screen TV, a scanner and a digital camera.

The Floresville technology project is yielding lesson plans that are shifting the classroom focus from the teacher to the students.

"This type of instruction is more likely to engage students in solving problems and using higher-order thinking skills, rather than memorizing the material," Ramos said. "Students who are interested in their studies are more likely to perform at a higher level."

In a science class, students do research on the Internet, incorporate their research into PowerPoint presentations and present conclusions to another group of students. Language arts teachers use a similar technique to get their students to write short stories and book reviews. Mathematics teachers use Excel spreadsheet software to teach graphing and to make presentations in class.

Ramos says the project has helped improve the district's scores on the Texas Assessment of Academic Skills (TAAS). Ninety-one percent of the district's eighth-graders (89 percent of Hispanic eighth-graders) passed the very difficult science portion of the assessment in 1999 and 2000. The Texas Education Agency has named Floresville a "recognized" school district for the last two years.

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**Contact: Melissa Ramos, Director of Instructional Technology**
**Floresville Independent School District**
**908 10th St.**
**Floresville, TX 78114**
**Phone: (830) 393-5300**
**Fax: (830) 393-5399**
**E-mail: mramos@floresville.isd.tenet.edu**
**Web site: www.floresville.isd.tenet.edu/dl**

# Career/Technical Programs

## Students learn space-age technology, build prize-winning solar car

A student's question about a movie led South Carolina high school students to design and build a solar-powered race car that won a top prize in a national competition. In the process, the students navigated the Internet, learned about space-age technology and raised $200,000 to support the project.

"No other high school students in the Southeast — and very few college students in this area — have accomplished this type of engineering feat," said Patrick Gunter, former teacher of computer-aided design (CAD) at Daniel Morgan Vocational Center in Spartanburg, S.C., where the project originated. Gunter now teaches pre-engineering at James F. Byrnes High School in Duncan, S.C. Both schools are in Spartanburg County, and the project now involves students from those schools and other high schools.

Team Pegasus was created after Ben Womack, a student at Daniel Morgan Vocational Center, saw the movie "Race the Sun" about students at a Hawaiian high school who entered a worldwide solar race. He asked Gunter if such a program existed in South Carolina. Auto racing is very popular in the state, so many students are interested in any project involving cars. Gunter searched the Internet and found out about the Winston Solar Challenge. Students at the vocational center decided to build a car and enter the race.

### *Business support*

After Gunter attended a Texas workshop designed to inform technology teachers about the upcoming solar race, he and his students obtained the school board's permission to proceed. Students developed a mission statement and produced a PowerPoint presentation about their objectives. They "pitched" the project to South Carolina business leaders and raised more than $200,000 to finance the project. The 100 sponsors included MPI Southern Fineblanking, BMW Manufacturing Corp., Cleveland White Realtors, and D.C. Motors and Controls.

The students worked with engineers nationwide to design a solar-powered car that they named Pegasus. They learned many mathematical, electrical and mechanical engineering skills. Although Team Pegasus was an extracurricular activity, much of the work took place in Gunter's computer-aided design classes. Various aspects of the car's electrical and mechanical design were incorporated into class time; the opportunity to work on a real-world project heightened the students' interest and enthusiasm for learning.

The car runs on solar cells called photovoltaic (PV) cells that are found in spacecraft and in many smaller items, such as calculators and watches. These silicon cells were developed in the 1950s for use in U.S. satellites. The students submitted a proposal to NASA to send cells similar to those used in the car on a 1998 flight of the NASA space shuttle Endeavor. Gunter took four students to the Kennedy Space Center in Florida to watch the launch. After the flight, the students examined the cells for any changes caused by temperature or pressure in outer space.

### *Internet connections*

The Internet was critical to the project's success. It enabled students to communicate with engineers and to locate necessary parts and equipment worldwide. The students used AutoCAD 2000 to design the car, Microsoft Office 97 Professional Edition to write correspondence, Microsoft Publisher 97 to produce graphics, and Microsoft FrontPage 98 to design and manage their Web page (www.teampegasus.org).

Many of the car's components were either computerized or computer-controlled. During the race, students used a data logger, a modem and a laptop computer to transmit data from the solar car to a chase vehicle. Students had to know voltage and current input and output in order to adjust the car's speed to various conditions of sun and terrain.

Working with the solar cells strengthened students' knowledge of geometry, configuration and design and introduced them to aerodynamics. Building the car's framework taught them to weld.

"Students had to use a tremendous number of mathematics and science applications to design and operate an electronic system," Gunter said. "Many engineers say they don't learn such real-world, high-tech applications until they have worked in industry for a number of years."

### *Students' commitment to the project*

To prepare for the race, students worked on the car from 5 to 10 p.m. during the week and longer hours on weekends and holidays. After the school year ended and before the race, the students worked 18 hours per day on the car.

"Universities with top-notch engineering programs may take two to three years to build a solar car," Gunter said. "Team Pegasus accomplished this task in only nine months."

The hard work paid off when the students won third place in the high school open division of the 1999 Winston Solar Challenge cross-country race from Dallas to Los Angeles. The students redesigned the car and took second place in 2000. Because they did not have to start from scratch, the preparation was less intensive.

In July 2001, Team Pegasus plans to enter the Winston Solar Challenge cross-country race from Dallas to Indianapolis with a new car that the students are designing and building. The students also want to participate in the World Solar Challenge in Australia in November 2001. This event, known as the "ultimate solar race," is a 10-day, 1,800-mile race across the Outback.

"One of the biggest hurdles in replicating this project would be to raise $200,000," Gunter said. "A school needs strong community support to conduct a project of this magnitude."

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**Contact: Patrick J. Gunter**
**Pre-engineering Instructor and Team Pegasus Adviser**
**James F. Byrnes High School**
**150 E. Main St.**
**Duncan, SC 29334**
**Phone: (864) 949-2355, Ext. 148**
**Fax: (864) 949-2397**
**E-mail: pjgunter@aol.com**
**Web site: www.teampegasus.org**

## Students flourish in Hawaii school's award-winning communications program

The quality of Waianae High School's Web site would lead anyone to believe that WHS students work in a state-of-the-art computer-editing and graphics facility. Not so, said Candy Suiso, coordinator of the Hawaii school's multimedia production program.

"People are amazed to find that students operate out of two small classrooms and edit videos in a closet," Suiso said. Only four years ago, the school received a grant to buy air conditioners to protect the sensitive computer equipment from the tropical heat and salty air.

Despite these challenges, the school's mass-media communications and journalism program — called Searider Productions — has received state, national and international awards and has prepared many students for college and/or high-paying jobs. Searider Productions is the state's largest high school mass-media program and the only one that combines hands-on television production, radio broadcasting, Web publishing, print

media, virtual reality, 3-D animation and music recording. More than 300 of the school's 2,250 students are enrolled in at least one communications class.

### *Exemplary projects*

Anyone can view student projects on the school's Web site. One project — "A Virtual Tour of the Waianae Coast" — placed third in the 1996 Global School Network International Schools Cyber Fair. This project contains maps, photos, history and legends. Another project that blended history and social studies with technology focused on the memories, special places and customs of the Hawaiian kupuna (elders). In April 1997, Hawaii magazine described the kupuna project this way: "The students created the content themselves by interviewing their kupuna, writing the stories, scanning and publishing historical pictures, and weaving it together in a wonderful way." The kupuna project won first place in the Maui High Performance Hawaii Super Computing Challenge in 1997; the student art section of the Web site won special recognition in the 1998 competition.

In a section of the Web site that contains photos and text from the state archives, some photos are moving images. The students used Smart Dubbing software to create GIF animation. The Honolulu Star-Bulletin newspaper's Web site said of this project: "Waianae is where you want to go to learn Web design....While many public and private schools have Web sites that look like brochures, the Searider site moves and tells a compelling story."

The student Web masters even created a Web site for an outside organization, the Waianae Coast Comprehensive Health Center. The center is the premiere health-care facility in the area.

### *A learning tool*

"We see technology as a tool for teaching and learning," Suiso said. She and colleague Norman Chock started Searider Productions in 1993. Suiso teaches classes in mass media, video newsmagazines, and television production and news writing. Chock teaches mass media, computer science, and A+ Certification and computer networking, as well as an American Problems social studies course. Teacher Lorraine Gershun, who joined Searider in 1996, teaches English, yearbook publishing and news writing for print media.

Students in the video newsmagazine course don't touch a camera until they do research and prepare a script. Teachers in the program who grade the scripts and the students' pre-production notes say students' writing skills have improved as a result of the program.

Mathematics also comes into play in working with technology, especially computer animation and music recording. Students must know algebra to create 3-D images, Suiso said. When creating music, students must time their beats perfectly in seconds and fractions of seconds. They record in digital multitracks and then mix, sequence and make masters of their original music.

### *Student-operated radio station*

In 1995, the school established a Searider radio station at 101.1 FM — Oahu's only radio station operated by high school students. In conjunction with the Waianae Coast Coalition, the station broadcasts on an FCC-licensed, community, low-powered frequency that covers one entire coast of Oahu. The programming features community and school activities, athletic events, public service announcements, music written by WHS students and community members, and a mix of local and popular music. Student radio announcers learn speech and technical skills that are needed in preparing and delivering radio broadcasts that both entertain and inform.

The mass-media program attracts a range of students, who begin with an introductory course about film, TV, music, newspapers, magazines and Web design. After the basic course, students may enroll in journalism courses to learn how to write for newspapers and video newsmagazines; broadcasting courses to prepare for careers in radio; TV production courses to learn how to make commercials, public service announcements, mini-documentaries/comedies/dramas and music videos; and advanced courses in computer multimedia.

Students always work in teams on the projects. "That's how it is in the real world," Suiso said.

"Every student can find something in this program," she said. "We have saved a lot of students who would have dropped out if they hadn't become interested in learning through technology."

Attendance in the courses is high, too. Because the courses are project-based, students see immediate results of their work, which keeps them involved and interested.

Several students have gone directly into high-tech or mass-media jobs as Web site designers, video editors for TV stations, and radio disc jockeys.

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**Contact: L. Candy Suiso, Coordinator**
**Phone: (808) 697-7048**
**E-mail: suiso@aloha.net**
**or**

Norman Chock
Phone: (808) 697-7036
E-mail: nchock@aloha.net

Searider Productions
Waianae High School
85-251 Farrington Highway
Waianae, HI 96792
Phone: (808) 697-7017
Fax: (808) 697-7018
Web site: http://www.k12.hi.us/~waianaeh/Project/home.htm

# Projects help business students become skilled, resourceful workers

Many businesspeople learn computer programs on their own by asking friends and colleagues for advice and reading instructional manuals. Eva Atkinson prepares business and computer technology students at Sussex Technical High School in Delaware for independent learning by expecting them to be self-reliant.

"All of my classes are based on making students responsible for their learning," she said. "Technology is changing so rapidly that workers need to be resourceful in learning new applications and solving tough problems."

Atkinson's instructional approach is particularly evident in the five-week projects that 11th-graders complete in the spring semester. Teams of students launch imaginary businesses and innovative new products. In doing so, they use personal computers, up-to-date software, color printers and electronic scanners to produce reports, correspondence, business cards, financial reports and brochures.

## *A small-business expo*

At the end of the project, students conduct a mock "small-business expo," during which each group makes an oral presentation and presents a multimedia slide show in front of teachers and the other groups of students. Atkinson and another teacher in the department judge the presentations based on students' evidence of preparation, creativity, product descriptions, prototype development and multimedia presentations. Atkinson evaluates other aspects of the project: correspondence, advertisements and brochures (reinforcing English standards); software proficiency, including installation and use of technical resources to learn new programs (development of technical skills); and group dynamics (workplace skills).

The students in each work group evaluate one another on factors such as the ability to work in a group, follow instructions, cooperate and meet deadlines. They also give one another scores for the actual work produced. The peer evaluations are taken with the teachers' assessments to form students' grades.

One challenge for a diverse group of students — just like in the workplace — is to learn to function as a team in order to make products, meet deadlines, create promotional materials and solve interpersonal problems.

At the end of the project, students answer a series of important questions. This step, the "final analysis," is essentially a report of students' thoughts and ideas about the process and the outcome. Typical questions include:

- What did you gain academically from the project?
- What new technical skills did you learn?
- What "real job" activities did you experience?

Students generally say that they:

- liked the project and wanted to do more like it;
- found out how the workplace "feels" and operates;
- learned new skills by relying on themselves and resources other than teachers;
- gained experience in meeting deadlines and producing real business documents; and
- learned to deal with difficult personnel issues that are typical of the workplace.

"I never realized how hard it can be to get some people to cooperate and just do their jobs," said one team leader. "I called on skills I had never used before and patience that I thought only teachers had."

Another student, who never had been employed, said she was grateful for the academic, technical and personal skills she gained through the business project.

"The projects inspire students to develop the best products and outdo the competition," Atkinson said. "Students are very proud of what they accomplish."

### *Best examples*

Atkinson says the "real value" of this project-based learning experience is the process, rather than the products. Even so, students have completed many excellent projects. One team created a travel agency; others developed new types of shoes and new audio equipment. One enterprising group created advertisements for all of the other student "businesses."

To ensure that students increase their technical skills, Atkinson requires each team to learn and use a new computer application by relying on computer manuals and each other. She said that "90 percent of the students respond very well" and the others realize the need to be self-sufficient as they observe their classmates solving problems and doing research.

Students are expected to take complete responsibility for their learning and their production. There are deadlines for project components, but the real challenge is to be ready for the final presentation on a date that is set in the beginning.

### *Team leaders*

Each team elects a leader, designates tasks for each member and sets internal deadlines. Once a week, team leaders meet as a group with the teacher to discuss group issues, such as problems with personnel, design, software or technology.

"Only team leaders may discuss problems with me," Atkinson said. "The best thing about these meetings is that students generally come up with all the answers and help each other."

Each year, Atkinson adds a project component or improves an existing one. In the first year, she began requiring team leaders to write reports; in spring 2001, she required teams to design Web pages for their businesses.

To replicate this assignment, a teacher would need computers and various software. Atkinson also recommends that teachers receive professional development in group dynamics and project-based learning. Ideally, a teacher would have four to six weeks to plan and develop this type of assignment.

Atkinson sees plenty of evidence that students grow academically and technically during the five-week project. They read a lot, write a lot and hone their research skills. They also learn vital workplace skills, such as working in teams, producing high-quality products and meeting deadlines.

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**Contact: Eva Atkinson, Business/Computer Technology Teacher**
**Sussex Technical High School**
**Route 9, Box 351**
**Georgetown, DE 19947**
**Phone: (302) 856-0961**
**Fax: (302) 856-1760**
**E-mail: eatkinson@sussexvt.k12.de.us**

# Alabama students learn environmental science from certified teachers via Internet

As any psychology student knows, we often want what we know we cannot have. An Oakman High School teacher had that reaction when an employee of the Alabama Power Co. showed him an expensive device for monitoring water quality. The monitor measures dissolved oxygen, temperature, conductivity, acidity and suspended solids. It also transmits the data to the company via telephone lines.

The teacher, Robert Youngblood, wanted such a gadget for students in his environmental science course. He initially received a tackle box filled with chemicals and instructional manuals. Later, he received a grant to buy high-tech monitors, which students use in field research and lab activities in agri-science, chemistry, physics and environmental science courses. Career/technical students, college-preparatory students and special education students are enrolled in the courses.

Youngblood's quest for unattainable equipment led to something even more valuable. Students began to investigate and document their relationships with the environment, their history and their community, as manifested in local water quality. Using computers and colorimeters (instruments for measuring the intensity and hue of colors) to detect environmental issues became a regular part of the school day at Oakman High School.

In 1999, Youngblood took the use of technology in teaching and learning to a new level when he authored one of the state's first online high school courses: "Environmental Science: A Look at Alabama's Watersheds." The course was the first offering of the Alabama Online High School, a project of the University of Alabama Program for Rural Services and Research. AOHS delivers asynchronous, Web-based instruction to a network of schools throughout the state. "Asynchronous" means that students and teachers do not have to be online at the same time; this feature allows for flexible scheduling.

Most students take courses during the school day in computer labs or media centers — anywhere there are computers connected to the Internet. Coordinators at the schools keep track of student progress. Students also may access courses from home. They receive course credit from their schools.

## *Milken award*

In 1999, Youngblood received a Milken Family Foundation National Award for the effective use of technology in teaching. The foundation makes cash awards of $25,000

each to teachers in 42 states each year. These teachers also have opportunities to communicate with other award winners, school leaders and policy-makers.

In creating the online course, Youngblood's initial goal was to provide another science elective for students in small rural schools. Alabama requires students to complete four English, four mathematics, four science and four social studies courses to graduate. Smaller schools sometimes have difficulty offering enough course options.

The online course combines independent study and collaborative research. Youngblood posts assignments on the OAHS Web site, which high school students statewide can access at their convenience. In the pilot phase in 1999-2000, the course was delivered to 32 students at five high schools. Students enter a password, view assignments, read instructions and add comments. They also post the results of Internet research done individually and in groups.

### *Online resources*

The course teaches students to evaluate and analyze water quality and usage in local watersheds, which are areas that drain into rivers and streams. Students gather data from various online resources, including Web sites maintained by the Alabama Department of Environmental Management, the U.S. Environmental Protection Agency, the Natural Resource Conservation Service and Alabama Water Watch, a nonprofit environmental group. They also collect information electronically from the U.S. Census Bureau and other agencies. Finally, they chart, graph, analyze and post the data they gather.

Youngblood reviews students' work and gives them feedback. Instead of giving traditional tests, he evaluates students' daily work. Students also keep journals of what they learn about science during the course. Because students work independently, they become responsible for their own learning. They hone their academic skills daily by writing reports, querying the instructor, manipulating numbers and analyzing data.

"Students' writing skills improve dramatically," Youngblood said. "They find reasons to use the mathematics concepts that have been difficult and meaningless to them in the past, and they build their computer skills considerably."

### *Final project*

In a collaborative research project that serves as a final exam, students produce and present multimedia presentations about the quality of water in their communities. These summaries of the status of students' watersheds are designed to be presented at formal community meetings.

Some formerly lackluster students have "come alive" after taking the course. One student who missed more than 20 days of school in one semester had perfect attendance after enrolling in the online course. A student who refused to use the computer for any practical purpose is now fluent in "Web talk." Students become very interested in their research as they begin to understand their communities' natural resources. They begin to spend more time making sure the data are accurate and studying the information they obtain.

It is too early to determine the course's impact on test scores, but the Alabama Department of Education has funded remedial science courses that will be based on the course. The U.S. Department of Agriculture has chosen the course as a model for other courses for rural students in several counties.

### *12 new courses*

The AOHS created 12 courses in other academic fields for the 2000-01 school year. The courses resulted from the efforts of the Program for Academic and Cultural Enrichment of Rural Schools, a cooperative for increasing students' educational opportunities. However, the online courses are gaining popularity among schools of all types and sizes.

After the initial year, Youngblood rewrote the online course to improve the instructional sequence and to include many new Web resources. The revised course addresses more directly the objectives of the Alabama High School Graduation Exam and the Stanford 9.

In October 2000, Youngblood became manager of services for the AOHS. He now works with a team of educators to link schools, school systems, teachers and students to maximize the use of asynchronous, Web-based instruction for all Alabama schools. In fall 2001, more than 20 academic courses and several electives will be available to Alabama students via the Internet. Professional-development courses for educators, community leaders and policy-makers also will be available online.

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**Contact: Robert Youngblood, Agri-science Teacher**
**University of Alabama Program for Rural Services and Research**
**205 University Blvd.**
**Tuscaloosa, AL 35487**
**Phone: (205) 348-6432**
**E-mail: ryoungblood@pacers.org**
**Web site: http://altair.pacers.org**

# Newspaper's Web site helps medical technology students improve communication skills

USA TODAY and its electronic resources are helping students in medical technology classes at Bucks County Technical High School in Fairless Hills, Pa., to develop several skills, particularly communication. Students have learned how to gather information more effectively and how to share information through oral and written presentations.

The newspaper's education program uses problem-solving content and activities to help students and teachers link news events to their lives. The paper's Web site shows how academic skills are applied in a variety of career fields. Students can ask journalists questions to learn their views on vital issues, such as health care.

As part of the USA TODAY education program, the school receives copies of the newspaper each day. Using newspaper stories and related maps, charts and graphs, students apply knowledge and reasoning skills in interpreting and evaluating data. Students involved with the program learn to seek information, explore ideas and form opinions.

## *New media center*

The school did not have computers when this project began, so the students used home computers to access the online materials. Their teacher, Donna Milner, also had to use a home computer to visit the Web site, which provides teachers involved in the program with daily lesson plans. Now that the school has a new building, students have access to computers in the media center, and there are plans to connect every classroom to the Internet.

Students in medical technology classes learn the clinical and administrative skills associated with a physician's office. They begin with the basics, such as hand-washing and sterilization, and move to more complex clinical procedures, such as electrocardiograms and venipuncture (the insertion of a needle into a vein). The administrative skills students learn include the use of telephones, computerized accounting and third-party billing. They learn the theories behind anatomy/physiology and medical law and ethics. Seniors participate in internships and other work-based learning experiences.

"Students planning to enter the health field need strong communication skills," Milner said. "Health care professionals spend a lot of time with their patients, and I think it is important for students to be able to talk intelligently about any issues that their patients might want to discuss."

Students say they are proud to be able to communicate in doctors' offices and other medical settings.

### *Not just health issues*

Milner encourages her students to study all issues — not just health issues — but says that many front-page stories are health-related. When USA TODAY did a story on the effects of drinking on teenagers' brains, she asked students to research and write about how these effects will show up in an MRI of the brain.

Students' written and oral communication skills improve steadily as a result of preparing and presenting summaries of the news. One girl who had weak reading skills at the beginning of the year earned a high score on her oral presentation for her senior project.

Mathematics skills get a workout when students analyze business stories on the economics of health care, and every medical story helps students improve their science knowledge and skills.

### *Lesson plans on the Internet*

Milner reviews lesson plans on the Internet each night for the next day's class. She gathers background articles for her lectures on topics such as in vitro surgery and eyesight restoration.

She also uses various techniques to engage students in learning. Sometimes she assigns a section of the paper to a group. In this setting, students learn to communicate the main points of articles convincingly. One student became particularly proficient in analyzing complex articles. Students who at first were reluctant to speak were vying for the top stories by the end of the school year.

One student did a senior project for her home high school and for the vocational school. She researched her project by finding articles on AIDS that had been archived on USA TODAY's Web site.

A national newspaper like USA TODAY broadens students' horizons. Medical technology students at Bucks County Technical School once were naive even about what was going on in the rest of the nation but now are learning about events worldwide.

"I wanted to get the kids out of the community, and USA TODAY has helped me do it," Milner said.

USA TODAY has formed a partnership with *High Schools That Work* to give teachers a resource for lesson plans that engage students in learning and improve their high school experiences.

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**Contact: Donna A. Milner, R.N., B.S.N., Medical Assistant Instructor**
**Bucks County Technical High School**
**610 Wistar Road**
**Fairless Hills, PA 19030**
**Phone: (215) 949-1700, Ext. 2068**
**Fax: (215) 949-2104**
**E-mail: milnerbsn@aol.com**

**Joyce Winterton**
**National Partnerships Manager**
**USA TODAY Education**
**1000 Wilson Blvd.**
**Arlington, VA 22229**
**Phone: (703) 558-5641**
**Fax: (703) 558-3986**
**E-mail: jwinterton@usatoday.com**
**USA TODAY Web site: www.education.usatoday.com**

## 'HERD-TV' sharpens students' academic, technical skills

Television is helping students at Carlisle High School-Center for Careers and Technology in Carlisle, Pa., polish their communication skills — not by watching TV but by producing and editing a program that is shown on a local cable access channel.

Students in grades nine through 12 learn many academic and technical skills by creating and producing a series of professional-quality TV programs that showcase activities in the Carlisle Area School District. The 30-minute "HERD-TV" programs, which feature aspects of the 5,000-student school system, appear Monday and Thursday nights. "HERD-TV" gets its name from the center's mascot (a bison) and the athletic team nickname (the Thundering Herd).

Student-produced programs must meet the standards of the cable industry, said John Augustine, director of the school district's Center for Careers and Technology, where the programs are produced.

### *Motivating students*

"When students are expected to produce something that is shown to the community every week, the level of intensity increases and students are motivated to do a good job," Augustine said.

The center teaches technical skills, such as using cameras and sound equipment, trouble-shooting technical problems and maintaining equipment. Students shoot raw video and use a computer to generate the final product. They must be able to use computers in general — and video-editing software programs in particular.

The project reinforces students' writing and speaking skills and develops planning and organizational skills. It also promotes decision-making, accuracy, conciseness, cooperation and teamwork.

### *No discipline problems*

"From the time they enter until they leave the class, students focus completely on the broadcast," Augustine said. "There are no discipline problems."

Interviewing people on camera and knowing that family and friends will be watching the program does wonders to motivate students to improve their communication skills. While some cable programs have few viewers, "HERD-TV" has caught on with the Carlisle school community. School administrators announce upcoming events on the program.

In one project, students produced a half-hour informational program about a local effort to teach English to adults who speak other languages. Students used mathematics in taking measurements and calculating where to set up microphones each day to get optimum sound quality. Because the program was taped in a room with block walls instead of on a sound stage, the students used physics in dealing with refracted sound.

### *Problem-solving skills*

"HERD-TV" allows students to practice real-life problem-solving skills, Augustine said. When equipment malfunctions, the students consult a trouble-shooting chart aimed at solving the problem. They make sure the equipment is plugged in and check other functions until they find the problem.

The class is very popular with students. "We're running seven 50-minute periods of the class right now, and that's our capacity because of the size of the facility," Augustine said. "We can't accommodate more than six to eight students per period."

Next year, the school will offer a one-period exploratory course to introduce students to "HERD-TV" and will double the length of the regular course. The number of sections of each course will depend on enrollment.

For career-bound students who take the class, school leaders plan to create a technical career pathway in broadcasting. They also want to tie other academic courses to broadcasting classes to create a pathway for students who plan to concentrate on video production. Students will take courses such as fine arts, graphics and desktop publishing.

To duplicate this program, a school would need to invest in computer hardware and software for video editing and should purchase commercial-grade cameras. A high-quality used camera would cost half of the $12,000 to $15,000 that a new camera costs.

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**Contact: John Augustine, Director**
**Carlisle High School-**
**Center for Careers and Technology**
**623 W. Penn St.**
**Carlisle, PA 17013**
**Phone: (717) 240-6872**
**Fax: (717) 240-2062**
**E-mail: augustij@planetcable.net**
**Web site: www.carlisleschools.org**

## Students learn computer skills at own pace

Students at Springdale High School in Arkansas don't wonder what they have to do to earn an A in a computer class. And they don't worry about being bored or overwhelmed by the work.

Traditional computer classes in the school's business technology department have been replaced with self-paced, mastery-learning classes that have specific learning goals. Students learn at their own pace and demonstrate that they have acquired the necessary skills to advance to the next level.

"Students are taking much more responsibility for their actions," said Kathleen Johnson, who teaches computer skills. "They are more likely to analyze problems and find solutions to improving their grades. They are also learning to set goals, meet deadlines and manage their time."

After being frustrated that some students were wasting time, Marilyn Carrell, head of the business technology department, teamed up with other business teachers, including Johnson and Karrie Combs, to revamp the school's computer courses in the 1999-2000 school year.

"We were teaching semester-long courses, and the advanced kids — those with computers at home — were bored to death," Carrell said. "But we couldn't skip the basics, because the beginning students needed the basic instruction."

### *Input from the business community*

Teachers from the business technology department polled other teachers about the computer skills that contribute to success in high school, college or careers. They also asked the school's advisory board of business experts to recommend computer skills and compiled a list of skills that business professionals need.

The teachers then reorganized the courses and got a waiver from state officials to teach computer skills in a new way. The courses at Springdale High School cover the same skills that the state wants taught — and more — but the skills now are arranged in an integrated software curriculum. The skills that students need in order to do well in school are taught in the first courses; the advanced courses teach more specialized skills.

The teachers' goals included:

- streamlining the computer studies curriculum;
- ensuring that students have adequate skills;
- meeting the needs of students with varying levels of computer experience;
- promoting students to higher-level courses and levels of learning as rapidly as possible while making sure they are competent; and
- teaching students to use their skills in solving problems rather than simply copying examples from the book.

In the past, many students could not type when they entered computer classes. As a result, the keyboarding curriculum has been revised. Now all eighth-graders — and students who transfer into the school — must complete at least two of three keyboarding modules. A module consists of nine weeks' worth of material. Students who meet this requirement earn A's; those who do not meet the requirement receive C's and must take a remedial keyboarding-applications course.

### *Students may 'challenge'*

Students who think they have learned the material in any course may decide to "challenge." These students take the unit test without completing the unit. If they score at least 80 percent on the test, they get credit for the unit and can move on.

The school's first three levels of computer applications classes are competency-based and self-paced. They cover topics such as word processing, Internet research, spreadsheets, presentation graphics and database management.

A 12th-grader who was having academic problems told Johnson, "This is the only course where I know I will make an A or a B if I complete the work."

In every computer applications course, students complete independent projects that have clear guidelines and goals. Many courses are cross-curricular, allowing students to do Internet research on topics from other courses.

### *PowerPoint presentations*

Students in one course develop PowerPoint presentations based on academic topics and completed with input from academic teachers. The students must "present" their projects to their computer classes. Many academic teachers give extra-credit points for research and presentation content. In preparing the presentations, the students learn to cite information from Internet sources. In advanced computer classes, students learn to use the style guidelines of the Modern Language Association and the American Psychological Association.

Students learning Excel software do independent projects that require them to research three different careers in three different states where they might want to live. They find the cost of living, the crime rate, the average daily temperature and other quality-of-living factors in those states and enter the information on a chart.

"Students use the same types of investigative methods that they use in doing reports and visuals for science fairs," teacher Danya Scheiderer said.

### *Advanced courses*

The Springdale teachers try to move students into advanced computer courses as quickly as possible while maintaining high standards. Some students complete three computer courses in two semesters.

All students eventually reach or exceed the 80 percent competency level on projects and other assignments. Teachers sometimes return the work for editing or improvement several times before a student achieves that goal.

"Since advanced students don't have to spend time on skills that they already have, they often are able to produce superb projects," said business teacher Doris Smith. On the other hand, less-advanced students can take their time and succeed.

Connie Williams, head of guidance and advisement at Springdale High School, said students get excited about their computer courses and take pride in their work. Students say they have set higher goals for themselves as a result of what they have learned.

### *Parents approve*

"Parents have been very responsive to our new teaching method," business teacher Cindy Whitaker said. "They appreciate the fact that their children are expected to do quality work. Parents and teachers have become a team to help students improve their skills."

Springdale students use computers equipped with Pentium I, II or III chips and loaded with Microsoft Word, Excel, PowerPoint, Access, Publisher, FrontPage and PhotoDraw. Students also use scanners and digital cameras to incorporate graphs, photos and videos into Web pages and presentations.

Schools that want to replicate the Springdale approach will need administrative support, Carrell said. She said that teachers who are interested in a similar project should experiment with the competency-based, self-paced method, keeping in mind that it may be difficult to implement at first.

Teachers must be willing to develop the syllabi, the lessons and the tests before they begin the new method. "With students moving at their own pace, some students will be ready for the later chapters very quickly," she explained. Teachers also must be willing to analyze the results and revise certain units without losing the focus of the project.

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**Contact: Marilyn Carrell, Chairwoman**
**Computer Technology and Business Education Department**
**Springdale High School**
**1103 W. Emma Ave.**
**Springdale, AR 72764**
**Phone: (501) 750-8719**
**Fax: (501) 750-8811**
**E-mail: mcarrell@shs.jonesnet.org**

# Students 'pay' for supplies, advice in creating videos for fictional companies

Students in an advanced computerized-video production class at the Career and Technology Center in Williamston, S.C., have a powerful incentive to solve problems on their own: If they ask the teacher a question, they have to pay for the answer! The rate is $60 per hour in "play money." Instructor Scott Rhymer says the fee is designed to encourage independent learning.

Working in groups of five, students organize make-believe companies and complete major projects on the theme "The Business of Running a Business." Each team names its company, creates a fictitious product, writes a goal and a mission statement for the business, and develops a budget. The students produce company materials — such as a descriptive brochure, a newsletter, stationery and business cards — that contain a student-designed company logo. Each group of students also writes, edits and records a radio commercial, a video commercial and an infomercial.

At the end of the project, the students display their products during an oral presentation to students, parents and school administrators. Each task appears on a grading sheet that lists the standards that it should meet.

## *Spending 'budget money'*

At the beginning of the project, students are given "budget money." Each team is expected to "purchase" or "lease" supplies — such as computers, floppy disks, compact discs, videotapes and Internet services — as needed.

Students even must purchase teacher assistance — called technical support — when they have questions or problems. The more questions students ask, the more budget money they spend. By the time students enroll in advanced video production, they should have learned everything they will need to complete the project and should not have to allocate much of their budgets for technical support.

"We want students to rely on their team members instead of the teacher," Rhymer said.

The projects are complex and time-intensive, so it is important that each team member contributes.

"If one person in your group slacks up, the whole project suffers," Rhymer tells his students.

### *Spell every word correctly*

The project puts students' language skills under close scrutiny. The grading sheet reminds students repeatedly that anything that has a spelling error will receive a grade of zero and they will have no opportunity to redo the work.

The unusual instructional methods get every student to participate, and administrators and parents support the teaching strategies 100 percent. Parents receive information about the project and the teachers' expectations. In fact, students and their parents sign a form saying that they have read about the expectations and agree to them.

Parents are encouraged to attend the final presentation at the end of the project. Ninety percent of parents attend the presentation; for many, it is the first time they have been to the school.

Students meet with teachers every Friday for a "board meeting," during which they review their progress and receive feedback on their accomplishments.

### *Academic and personal skills*

The project requires students to use academic skills (reading, writing and mathematics) and personal skills (planning, analyzing and working in teams). Students keep a daily journal of their accomplishments. Each item of the project is graded on grammar and spelling as well as on the fundamentals of video production. English teachers often help assess the written work.

Students create imaginative companies and products. The Bad Mood Co. produced a skin lotion that made people feel good. Another company manufactured a yard spray that eliminated the need to cut or weed to have a healthy green lawn. A third company wanted to invent a way to reduce moving costs by shrinking furniture to the size of a pill and then restoring it to its original size after the move. "The students used physical and scientific terms to explain what they proposed to do," Rhymer said.

The principles of free enterprise emerge during the class. For example, a student who knows the answer to another student's question will sell the answer for less than it would cost to ask a teacher.

As in the real world, there are consequences for a student who does not hold up his or her part of the bargain. Team members can give a student a warning, document the complaint and write a letter to the teacher. Most problems are solved when the teacher reminds the delinquent student that "getting fired" carries with it a grade of zero in the course. If the warning is ignored, the team by unanimous vote can fire the student.

"The goal in this project is to show students that a career in their field requires academic as well as technical skills," Rhymer said. "In this project, the academic skills are just as important as the technical skills."

If the technical part of an assignment is good but the academic part is not, a student's grade will be lower.

Working in groups also helps to prepare students for the workplace. Students learn that working together to achieve a common goal is essential to success in the workplace.

"Employers come looking for these kids," Rhymer said. They are impressed by the work in the students' portfolios and want to know what these young people can do for a real business.

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**Contact: Scott Rhymer, Computerized Video Production Instructor**
**Career and Technology Center**
**Anderson School Districts 1 and 2**
**702 Belton Highway**
**Williamston, SC 29697**
**Phone: (864) 847-4121, Ext. 118**
**Fax: (864) 847-3539**
**E-mail: Rhymers@andersonctc.k12.sc.us**

## Students spearhead technology project that benefits school, community and state

The Student Technology Leadership Project at East Jessamine High School in Kentucky is truly student-driven. Students install computer networks, operate the school's help desk, train teachers and community members, make videotaped school announcements, and develop Web pages for nonprofit organizations.

"The teacher doesn't say 'it can't be done,' 'we don't know how,' 'no one wants to do that' or 'maybe next year,' " said Charlanne Pook, the technology coordinator for the school district. "Instead, she encourages students to discover for themselves whatever they want to learn."

When the school's Webmaster — an 11th-grader — received permission to redo the school's Web site, the teacher urged him to show ingenuity. The student searched the Internet, consulted a book that explained Flash software (an Internet language that contains animation) and did what no one else at the school knew how to do.

### *Three options*

Students participate in the project in a regular class, as independent study during the school day or as an after-school activity. Students in the class or independent study receive credit, and those who work for the district after school are paid.

"Students are encouraged to move forward, yet they are allowed to set their own goals and work at their own pace," Pook said. "Students select a focus for their work. For example, if they want to develop videos, they work on the announcements that are shown at the school each morning or on the senior video project."

The daily announcements contain student announcers, video clips and student-produced commercials. As soon as one day's announcements are delivered, students working on this project begin working on the video for the next day. In the senior video project, students produce a videotape of 12th-graders as a fund-raising activity.

### *Staff development*

Some students provide local teachers and district and state personnel with staff development. The training, which Pook said has been very successful, focuses on several software packages, Web page development and video streaming (placing video footage on the Internet).

Students offer technology training at the school and at the district-sponsored Jessamine Educational Technology Conference each August. They receive good evaluations from the teachers and administrators who attend the conference.

The Kentucky Department of Education also has benefited from the training and services delivered by EJHS students. One student developed a Web page for the Department of Education, and several students traveled to Frankfort, Ky., to train state personnel to use a Web wizard for entering data. One student developed a PowerPoint manual — which now is used in the Department of Education and in schools statewide — and provided training in how to use PowerPoint to make presentations. This student developed the manual while in middle school and revised it when a new version of PowerPoint came out. He and several classmates have made presentations at the state's annual technology conference.

EJHS students are very involved in the community. They teach how-to courses on the Internet and other types of technology and help local and state nonprofit groups develop Web sites. A few years ago, the district received a grant to purchase a Web server that enables the students to host nonprofit organizations' Web sites free of charge.

These students also handle the "networking" of the school's computer equipment. Several students have earned national certification as network administrators.

Students are graded on what they learn, what they produce and the process they use in completing a project.

"We have seen a definite increase in reading comprehension and problem-solving skills in this group of students," Pook said.

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Contact: Charlanne Pook
District Technology Coordinator/
District Extended School Services Coordinator
Jessamine County Schools
851 Wilmore Road
Nicholasville, KY 40356
Phone: (859) 887-9502
Cell phone: (859) 361-3272
Fax: (859) 887-9051
E-mail: cpook@jessamine.k12.ky.us

## Students go high-tech in estimating costs of car repairs

Computer technology at the Randolph County Vocational-Technical Center in Elkins, W.Va., helps students in a collision-repair technology class improve their academic and technical skills while removing dents from automobiles.

Teacher Carman Pennington designed the project based on suggestions from the auto repair professionals who serve on the program's advisory committee. In an exercise that is virtually identical to what happens in a real auto-body shop, students use a computer to estimate the costs of repairing wrecked vehicles.

The software program was donated to the school by the owner of a local auto-repair shop, who stipulated that it could be used only by students in the collision-repair technology class. In addition to teaching students how to write estimates, the program helps students learn the names of automobile parts, where they are located and how to remove them. This software program helps students improve their reading, writing, problem-solving and word-processing skills.

### *Electronic folders*

At the beginning of the project, each student sets up an e-mail account. Using laptop computers, the students write collision estimates, e-mail them to the teacher and

print copies for their personal folders. Students also use the folders to store information on careers in auto-body repair. Students save their estimates on a diskette in case they have to resubmit them.

Students use the Internet to search for new and used auto parts. They also visit Web sites (such as www.cx.bridges.com) to learn about career development. Students who want to know about job availability statewide and nationwide can get the information at America's Job Bank (www.ajb.org).

The professionalism in this course motivates students to do their best. One student who had been a chronic discipline problem got interested in the computer program. He began attending school regularly, graduated with his class and now works in a local body shop.

To duplicate this assignment, students would need access to a computer with an Internet connection and would need e-mail accounts. They also would need access to a software program for writing estimates.

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**Contact: Carman Pennington, Collision-Repair Technology Teacher**
**Christina Sanders, Technical Integration/School-to-Work Coordinator**
**Randolph County Vocational-Technical Center**
**200 Kennedy Drive**
**Elkins, WV 26241**
**Phone: (304) 636-9195**
**Fax: (304) 636-9169**
**E-mail: cpenning@access.k12.wv.us**
**cbsander@access.k12.wv.us**

## Grass is always greener at West Brunswick High School

Greener grass on North Carolina golf courses can mean brighter futures for horticulture students at West Brunswick High School.

More than 30 golf courses are near the school's Shallotte, N.C., campus, so agriculture teacher Dan McGougan uses the science of cultivating grass to teach his students about computer-aided design (CAD), mathematics, biology and business.

Faculty in the school's agriculture department developed a horticulture program that specializes in turf-building and landscaping. The outdoor laboratory features a golf green, a fairway, a golf tee area, a greenhouse for teaching floriculture, a plant-identification area and a nursery stock area. Sea Trail Plantation, a local golf course, donated equipment to enable students to maintain the greens each day.

### *Donated computers*

Students in most of the school's horticulture courses use a CAD program called Site Designer II to design the landscapes that they install. Brunswick Electric, a local utility company, donated computers for the students to learn the CAD program. In return, the class designed and installed a landscape (including irrigation) at one of the company's new buildings. The school system recently equipped the school with a seven-station computer lab for students in the four introductory courses and the advanced course.

Students designing landscapes must draw upon their mathematical skills to calculate how many gallons per minute an irrigation system needs, what diameter of pipe to use and how many sprinklers to install. Students have to figure out the square footage of an area and use coordinates to draw lines on a map.

Juniors and seniors use the Internet to research topics related to turf grass, landscaping or water quality.

### *Advanced studies*

Seniors who have completed a sequence of four agriculture courses (Horticulture I and II, Turf and Landscaping, and Landscape Design) may enroll in the challenging Advanced Agricultural Studies (AAS). Brunswick Community College awards college credit to students who master the Turf and Landscape course and the Landscape Design course.

All seniors at West Brunswick High School are required to complete a senior project that combines academic and technical skills. Students in AAS and 12th-grade English prepare papers, products and presentations that satisfy the requirements for both classes.

Students in the advanced agriculture course use e-mail to find adult mentors to serve as consultants and advisers for the projects. These mentors have included university researchers, cooperative extension agents and other government employees.

"One advanced class had e-mail mentors from as far away as Texas and Florida," McGougan said.

"I teach the students how to request information," he said. "They write e-mails inviting experts to correspond with them and then follow up with questions to gather the information they need."

### *Making presentations*

Two weeks before graduation, the students display their work and make presentations to friends, family and local mentors.

"We hold several practice sessions to build students' confidence, give them experience in making speeches and tailor the presentations to a certain time frame," McGougan said.

Technology plays a big role in the presentations. Students receive credit for scanning photos and using PowerPoint software to create presentations. They demonstrate the latest technology in irrigation, equipment calibration and chemical use.

Horticulture students participate in paid and unpaid internships at local golf courses and landscaping companies. Many unpaid internships develop into paid summer jobs.

Beginning in Horticulture II, all students keep portfolios of school and work experiences. The portfolios contain completed projects and disks of CAD drawings, PowerPoint presentations, photos, videos and work records. The students use these portfolios to obtain college admission, scholarships, job interviews and bank loans.

The advanced agriculture program attracts both college-prep and vocational students seeking to complete a career cluster in high school. Five students who completed the advanced program in 1999 entered state universities, two enrolled in Brunswick Community College, three got jobs and two entered the Air Force.

"Our program prepares students for whatever career they want to pursue," McGougan said.

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**Contact: Dan McGougan, Horticulture Teacher**
**West Brunswick High School**
**550 Whiteville Road**
**Shallotte, NC 28470**
**Phone: (910) 754-4338**
**Fax: (910) 754-3110**
**E-mail: dmcgoug[illegible]@infoave.net**

## Students use computers, marketing skills to create Internet-based businesses

Want to get in on the ground floor of an e-business? If so, keep an eye on 11th-graders who study marketing at Madison Comprehensive High School in Mansfield, Ohio.

In the last nine weeks of the junior year, each budding e-tycoon develops a comprehensive design for an Internet business. Students may choose any reasonable, potential-

ly viable focus for the business. Some e-businesses have specialized in clothing, compact discs and Web design. The project improves English, mathematics and science skills; reinforces students' knowledge of business and economics; and puts them in direct contact with business leaders.

The project has five parts: 1) a core business plan; 2) an operations plan; 3) a financial plan; 4) a marketing plan; and 5) a human resources and legal plan. In completing the project, each student is required to use Microsoft Word for the written plan, Excel for financial spreadsheets, PowerPoint for the final presentation, Publisher for an advertising campaign, Project for an implementation time line, and FrontPage for a mock-up of the Web site.

Students also use advanced Web design software, including Dreamweaver, Freehand and Flash. In creating advertising materials, the students use Photoshop, Pagemaker and Illustrator.

### *Modern computer lab*

The school has a cutting-edge computer lab with 24 computer stations. Students have access to color printers, scanners for custom graphics and photos, and clip art from MasterClips and ClickArt software. They use state-of-the-art video and digital camera equipment to incorporate actual and virtual pictures and videos of real people and situations into their presentations.

In addition to technology skills, students learn market research, financial planning and advertising/promotional design.

The project helps students to improve their planning and management skills. Teachers encourage them to use flow charts and other methods in planning and organizing the businesses. In completing the project, students are required to apply what they learned about business foundations and economics in the first nine weeks of the program. These skills include accounting, entrepreneurship, marketing and business law.

English and mathematics teachers are available to guide the marketing students in developing and writing financial plans. They teach students to create spreadsheets of start-up costs, balance sheets, cash-flow statements and income statements. They help students proofread and revise written plans. Students conduct a market research survey to learn the basics of scientific sampling.

"This project really challenges students," said David Logan, interactive media instructor. "They feel some of the pressures that actual businesses face."

### *Interviewing business leaders*

The project causes students to venture into the real world. In a typical day, students may interview business leaders by phone, fax or e-mail, or they may meet with people who can help them research their projects.

Advanced technology dramatically improves the efficiency of this project. For example, it is much quicker and easier to develop an advertisement on the computer than to cut and paste ads. Mistakes are simpler to correct, and fewer materials are wasted in redoing a layout.

Students are able to work at their own pace. When doing a project on the computer, students who make rapid progress can move to the next level, while students who need more time can repeat lessons until they master the skills.

The project changes each year to keep pace with technology. For example, the businesses were not required to be Internet-based until 2000.

### *Teacher's experiences*

Logan's experiences in the private sector contributed to the project's success. He did marketing and business planning in corporations and small businesses before he became a teacher.

To conduct such a project, a teacher would need to know how to use technology and how to start a business. Help is available from the Small Business Administration, the local chamber of commerce and other business-related agencies. The SBA Web site (www.sba.gov) is particularly helpful to students doing this type of project.

"This project gives students a taste of college-level work and real-world situations," Logan said. "The skills these students are learning are the same ones they will be expected to know after high school."

The project improved most students' grades in English and mathematics and helped students explore their interests.

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**Contact: David Logan, Interactive Media Instructor**
**E-mail: dlogan@madison-richland.k12.oh.us**
**or**
**Nancy Mowry, Career Pathways Coordinator**
**E-mail: nmowry@madison-richland.k12.oh.us**
**Madison Comprehensive High School**
**600 Ealey Lane**
**Mansfield, OH 44905**
**Phone: (419) 589-2112**
**Fax: (419) 589-2533**

# Integrated Academic and Career/Technical Studies

## Students use technology in studying environmental science

When Tony Hiatt's students say their environmental science class is "going nuclear," they probably aren't using a slang expression for anger.

Hiatt's students at South Newton High School in Kentland, Ind., use devices similar to Geiger counters to measure radiation. The experiments teach them principles of science and mathematics that would be difficult to learn from ordinary textbooks.

"These experiments make science more real," Hiatt said. "They enable students to connect what they are learning to their lives and goals."

In 1999 Hiatt received the President's Award as Indiana's best high school science teacher. The annual award is sponsored by the National Science Foundation and the American Association for the Advancement of Science in cooperation with the White House. Hiatt was runner-up for Indiana Teacher of the Year in 1998.

### *Hands-on science*

Hiatt's hands-on approach to science reflects the school's efforts to incorporate technology throughout the curriculum. John H. Frischie, director of education and technology, says students are required to present what they learn. They often use multimedia programs, such as PowerPoint and HyperStudio, to incorporate sound, images, charts, graphs and video clips.

Students in Hiatt's biology classes collect information from the Internet and use a computer spreadsheet program to graph and analyze the data. His Advanced Placement biology students report each week on studies that appear in professional journals and on the Internet.

In the Advanced Placement environmental science course, the radiation project involves a nuclear scaler — a type of Geiger counter that produces digital readouts of radiation — and kits that contain radioactive samples. The radiation in a sample is low — about the same as the radiation emitted by an illuminated watch dial. In fact, students remove their watches in class to keep from skewing the measurements.

## *Expert speaker*

The samples help students to learn the three basic types of radiation — alpha, beta and gamma — and to see how easily they penetrate shields. A nuclear energy expert from a U.S. Navy nuclear power plant sometimes comes to the school to speak to Hiatt's class.

Hiatt has been borrowing nuclear scalers from Purdue University but says the high school is seeking a grant to purchase such devices. Other teachers at the school use similar devices to teach abstract concepts in mathematics and science.

"The whole concept of half-life, which is a measure of how fast radioactive atoms break down, is an application of a mathematical concept learned in Algebra II," Hiatt said. "By constructing a graph of their data, students can see a mathematical concept applied to real-world data."

## *Real-world lessons*

The mathematics and science teachers at South Newton use various probes for data collection so that students can apply the concepts they learn.

"Most students don't learn well by sitting and listening to lectures," Hiatt said. "The more students use technology, the more interested they become and the more they learn."

Frischie says all students need to be comfortable with technology. "If you don't know how to use a computer when you graduate from high school, you are illiterate in today's world," he said.

In 1995, Frischie received a Milken Family Foundation National Educator Award, which is given to teachers, principals and other educators who are promoting excellence in education. Frischie received this honor partly because he emphasized using technology to help prepare students for emerging careers in agriculture.

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**Contact: John H. Frischie, Director of Education and Technology**
**E-mail: frischiej@is01.newton.k12.in.us**
**or**
**Tony Hiatt, Science Teacher**
**E-mail: Hiattt@is01.newton.k12.in.us**
**South Newton High School**
**13102 S. 50 East**
**Kentland, IN 47951**
**Phone: (219) 474-5167**
**Fax: (219) 474-6592**
**Web site: www.mwprairienet.lib.in.us/Education/South_Newton/sn-sr-high.html**

# Employers view students' video résumés on Internet

Students in electricity, carpentry and masonry classes at Highland Springs Technical Center in Virginia demonstrate their academic and technical skills in videos that potential employers can see on a special Web site. Making these videos teaches the students what it takes to be professionals in these fields.

Five years ago, electricity teacher Brad Beazley began videotaping students as they demonstrated their technical skills in wiring and construction. He sent the tapes to local electrical contractors and asked for their opinions of the students and their skills.

The approach was so successful that it evolved into a full-blown video-résumé project. Students write speeches about themselves, including biographical information, the courses they are taking at the technical center and their goals for the future. They use the Internet to do research on their chosen career fields and use a computer to write their papers. An English teacher often reviews the papers for grammar, organization and other writing skills and grades the papers as research papers for English classes.

As they do the research and write the reports, students realize that they will need to learn mathematics if they expect to own businesses, prepare budgets for electrical projects and/or earn electrical engineering degrees in college.

## *Demonstrating their skills*

In the second part of the video résumé, students describe and demonstrate how they would complete a project. As they install an electrical box or wire a room, they explain for the camera — and for potential employers — the steps that they are taking to complete the project. These explanations involve high levels of communication, mathematics and technical skills.

In March 2000, the school received a $10,000 grant from technology services giant MediaOne (now AT&T Broadband) for a studio and new equipment. Highland Springs Technical Center was one of 10 schools — and the first technical center — to receive this Community Outreach and Online Learning (COOL) award. As part of events surrounding the awards ceremony in Washington, Beazley, the school principal and two of Beazley's colleagues received technical training in the Internet and other applications from MediaOne. They also were able to meet with other award-winning teams and to discuss a range of educational issues. They toured the Discovery Channel, where they learned that lesson plans on technology and other subjects are available at Discovery's Web site.

The grant money has been put to good use. A team of teachers (Beazley; Mike Phillips, an electricity teacher; Brad Orr, a carpentry teacher; and Glenn Edwards, a masonry teacher) built a studio in the electricity classroom, bought digital camera equipment and developed a Web site to display the videos. The studio also contains a computer for editing the videos before they are placed on the Internet.

## *Equivalent of an apprenticeship*

Students enter Highland Springs Technical Center in grade 11 and spend half of each school day there. (The other half is spent at the home high school.) In the second half of grade 12, students spend their half-day of technical center time in work-based learning. In two years, students can complete the equivalent of a one-year apprenticeship as an electrician.

The center's emphasis on technology is a boon to the work-based learning program. One of the center's goals is to get regular feedback from workplace mentors. In 2001, the mentors will be able to give electronic feedback about students who work with them.

"They will be able to e-mail me daily to let me know how students are progressing and what they need to learn to be ready for the real world," Beazley said.

The students' achievement levels vary, and many students need to improve their language arts, mathematics and science skills. As a result, the electricity teacher often works with academic teachers to integrate those subjects into his lesson plans. An algebra teacher provides input on how to teach the mathematics concepts that are used routinely in the electrical field. Mathematics teachers from the sending schools sometimes bring their students to the technical center to see Ohm's law in action in electricity classes and the Pythagorean theorem in practice in carpentry classes.

"I complained at first when my principal asked me to teach technical reading and writing in electricity classes," Beazley admitted, "but my boss was right. Employers want apprentices and full-time workers who are able to communicate effectively."

## *Privilege to be on the Web page*

Because of limited space (only 10 résumés at a time), students compete for the privilege of being featured on the Web page. Only the best project demonstrations are chosen. The competition has made students even more aware of the academic, technical and personal skills that will help them get and keep good jobs. "The level of professionalism of these students has increased tremendously since we began to make electricity courses high-tech," Beazley said.

Students are not as nervous or shy about being videotaped as they once were, and they now understand what the project can mean to their success in school and in the workplace.

In a new project, teams of students analyze sections of the Occupational Safety and Health Administration (OSHA) guidelines and write three- to five-page summaries of the regulations. They are videotaped as they present their summaries. The videotapes are shown to electrical contractors, who choose the best report. The winning team of students is invited to conduct a safety meeting for employees of a large electrical-contracting company in the community.

This program has opened students' eyes to the uses of technology and the need for high-level learning in high school. It has helped students gain skills that they never expected to need.

Beazley and other teachers organized the Tech Ethics Society to encourage a strong work ethic. Modeled after the National Honor Society for academic achievement, the society recognizes students who maintain good grades, good attendance and good work habits. Although teachers expected to honor about 15 students in the first year, 52 students qualified.

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**Contact: Brad Beazley, Electricity Teacher**
**Highland Springs Technical Center**
**100 Tech Drive**
**Highland Springs, VA 23075**
**Phone: (804) 328-4075**
**Fax: (804) 328-4074**
**E-mail: beazley60@hotmail.com**
**Web site: www.henrico.k12.va.us/hs/highsprtech/tcp**

## Technical school's Web site valuable to teachers, students

Since it began in 1991 as a comprehensive, technically oriented high school serving almost 1,100 students, POLYTECH High School in Woodside, Del., has used cutting-edge technology to prepare students for work and further education. In fact, one of the school's strategic goals is to:

- keep pace with technological advances by establishing ongoing relationships with businesses;
- develop a capital plan to acquire the latest technology and ensure that students learn to use it;

- prepare teachers to use cutting-edge technology; and
- develop a process to make sure the curriculum keeps pace with changes in technology.

Technology is an integral part of each of POLYTECH's 19 technical areas, which include the automotive and construction fields as well as the state's only aviation/flight training program. Students have access to the latest equipment and know-how.

### *More than 700 computers*

In addition to its more than 700 computers for student and teacher use, POLYTECH has state-of-the-art shop-specific technology. For example, students who participated in an integrated project to restore a Tomahawk airplane on the school grounds used the $80,000 paint booth in the auto body shop.

To support POLYTECH's teaching and learning activities and to facilitate communication with the community, the Kent County School District developed a Web site for the high school. The Web site provides a quick, up-to-date source of information about the school and contains resource materials for teachers and students.

Managers of the school's five academies quickly recognized the Web site's potential and worked together to create a format and procedures for students to place their academy portfolios on the Internet instead of on a shelf in the school library. These "living documents" chronicle students' achievements and allow them to build on their accomplishments year after year.

The technology infusion specialist — the district's Webmaster — coordinated training for a Web manager from each academy. The five managers serve as liaisons between the academy teachers and the Webmaster in organizing and placing data into the students' portfolios on the Web page. The portfolios contain evidence that students have done work that integrates academic and technical studies. As part of the training, the teachers maintain their own Web pages; this activity gives them the knowledge and experience to help students advance technologically.

### *Using the school's Web site*

After entering the POLYTECH Web site (www.polytech.k12.de.us), a user can click on "High School" and then "Academy Information." Here, he or she will see goals and integrated activities for each academy.

Chemistry teachers looking for lesson plans on the pH factor will find a lesson on pH, toxic compounds and thermal pollution. The lesson contains objectives, activities, resources and a suggested assessment.

POLYTECH is continuing to train and encourage teachers and students to use technology. It plans to add more student-generated works to the electronic portfolios and to increase communication with parents and the community.

In the 2000 *High Schools That Work* Assessment's survey section on "raising expectations in vocational classes," 94 percent of POLYTECH students said they used computer skills in completing vocational assignments.

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**Contact: W. Scott Kemerling, Principal**
**E-mail: skemerli@polytech.k12.de.us**
**or**
**Christy Wong, Technology Infusion Specialist**
**E-mail: cwong@polytech.k12.de.us**
**POLYTECH High School**
**823 Walnut Shade Road**
**Woodside, DE 19980**
**Phone: (302) 697-3255**
**Fax: (302) 697-4954**

# Key Practices

- **High expectations** — setting higher expectations and getting more students to meet them.
- **Vocational studies** — increasing access to intellectually challenging vocational and technical studies, with a major emphasis on using high-level mathematics, science, language arts and problem-solving skills in the modern workplace and in preparation for continued learning.
- **Academic studies** — increasing access to academic studies that teach the essential concepts from the college preparatory curriculum by encouraging students to use academic content and skills to address real-world projects and problems.
- **Program of study** — having students complete a challenging program of study with an upgraded academic core and a major.
- **Work-based learning** — giving students and their parents the choice of a system that integrates school-based and work-based learning. The system should span high school and postsecondary studies and should be planned by educators, employers and employees.
- **Teachers working together** — having an organization, structure and schedule giving academic and vocational teachers the time to plan and deliver integrated instruction aimed at teaching high-level academic and technical content.
- **Students actively engaged** — getting every student involved in rigorous and challenging learning.
- **Guidance** — involving each student and his or her parents in a guidance and advising system that ensures the completion of an accelerated program of study with an in-depth academic or vocational-technical major.
- **Extra help** — providing a structured system of extra help to enable students who may lack adequate preparation to complete an accelerated program of study that includes high-level academic and technical content.
- **Keeping score** — using student assessment and program evaluation data to improve continuously the school climate, organization, management, curricula and instruction to advance student learning and to recognize students who meet both curriculum and performance goals.